Technical Assistance Report

Project Number: 48029-001
Policy and Advisory Technical Assistance (PATA)
December 2014

Mongolia: Coal to Cleaner Fuel Conversion for Heating in Ger District and Power Generation

Asian Development Bank

CURRENCY EQUIVALENTS
(as of 29 October 2014)

Currency unit	–	togrog (MNT)
MNT1.00	=	$0.00053
$1.00	=	MNT1,852.00

ABBREVIATIONS

ADB	–	Asian Development Bank
CTL	–	coal-to-liquid
TA	–	technical assistance
WHO	–	World Health Organization

NOTE

In this report, "$" refers to US dollars

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POLICY AND ADVISORY TECHNICAL ASSISTANCE AT A GLANCE

1. Basic Data — **Project Number:** 48029-001

Project Name	Coal to Cleaner Fuel Conversion for Heating in Ger District and Power Generation	**Department /Division**	EARD/EAEN
Country	Mongolia	**Executing Agency**	Ministry of Mining and Energy
Borrower	Government of Mongolia		

2. Sector	**Subsector(s)**	**ADB Financing ($ million)**
✓ Energy	Conventional energy generation	0.35
	Total	**0.35**

3. Strategic Agenda	**Subcomponents**	**Climate Change Information**	
Inclusive economic growth (IEG)	Pillar 1: Economic opportunities, including jobs, created and expanded	Climate Change impact on the Project	Low
Environmentally sustainable growth (ESG)	Urban environmental improvement		

4. Drivers of Change	**Components**	**Gender Equity and Mainstreaming**	
Governance and capacity development (GCD)	Institutional development	No gender elements (NGE)	✓
Knowledge solutions (KNS)	Application and use of new knowledge solutions in key operational areas Knowledge sharing activities Pilot-testing innovation and learning		
Private sector development (PSD)	Promotion of private sector investment		

5. Poverty Targeting		**Location Impact**	
Project directly targets poverty	No	Nation-wide	High

6. TA Category: B

7. Safeguard Categorization Not Applicable

8. Financing

Modality and Sources	**Amount ($ million)**
ADB	**0.35**
Sovereign Policy and advisory technical assistance: Technical Assistance Special Fund	0.35
Cofinancing	**0.00**
None	0.00
Counterpart	**0.00**
None	0.00
Total	**0.35**

9. Effective Development Cooperation

Use of country procurement systems	No
Use of country public financial management systems	No

I. INTRODUCTION

1. During discussions for the country operations business plan, 2014–2016 for Mongolia of the Asian Development Bank (ADB),[1] the Government of Mongolia requested ADB to provide policy and advisory technical assistance (TA) for Coal to Cleaner Fuel Conversion for Heating in Ger District and Power Generation.[2] The proposed TA will promote the production and use of cleaner fuel from a coal-to-liquid (CTL) process. The technology will capitalize on abundant domestic coal resources for heating and power generation while reducing air pollution and dependence on imports of petroleum products.

2. The TA is aligned with ADB's interim country partnership strategy, 2014–2016 for Mongolia, which underscores the need to (i) foster energy security, (ii) reduce emissions of pollutants from heating and power generation facilities for urban environment improvement, (iii) explore ways of using cleaner fuel for power generation and heating supply, and (iv) promote private sector investment in energy infrastructure.[3] The concept paper was approved on 24 October 2014. During the fact-finding mission, ADB and the government reached an understanding on the impact, outcome, outputs, implementation arrangements, and outline of terms of reference for the TA consultants. The design and monitoring framework is in Appendix 1.

II. ISSUES

3. Energy security, climate change, and air pollution are major challenges common to most of ADB's developing member countries, especially those with fossil fuel-based economies. Mongolia is one of these countries. Coal is abundant and is the only fossil fuel available in the country.[4] Mongolia depends almost entirely on domestic coal production and imported oil for its energy supply. Energy security concerns are rising because of oil price volatility and its sharp increases in the past. Political instability in major oil-producing countries and the formidable difficulties of transporting oil in landlocked Mongolia have compounded these concerns. The consumption of petroleum products is growing rapidly in parallel with economic growth fueled by the country's mining sector.[5] Every year, Mongolia spends a higher percentage of its foreign exchange reserves on oil imports.[6] It also experiences frequent supply shortages because of vulnerabilities across the supply chain. This is causing a ripple effect on mining and industry—its main economic sectors.

4. Air pollution from conventional fuels is also taking a toll on Mongolians' health. Combustion of solid fuels, such as firewood and coal, in household heating stoves and cooking in Ger District of Ulaanbaatar causes indoor pollution, which leads to respiratory diseases.[7] Solid fuel combustion is also the largest contributor to outdoor particulate matter in Ulaanbaatar.[8] *Ger* districts are not connected to Ulaanbaatar's district heating system, so *ger* residents must use coal and wood for heating during the cold winters, which last for 6–8 months.

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[1] ADB. 2014. *Country Operations Business Plan: Mongolia, 2014–2016*. Manila.
[2] The TA first appeared in the business opportunities section of ADB's website on 28 October 2014.
[3] ADB. 2014. *Interim Country Partnership Strategy: Mongolia, 2014–2016*. Manila.
[4] Mongolia is estimated to have 6.2 million tons of oil reserves. All locally produced oil is exported to refineries in the People's Republic of China because there are no in-country refineries.
[5] Mongolia imported 1.1 million tons of oil in 2012 and consumption is expected to reach 2.5 million tons in 2020.
[6] Mongolia paid about $1.4 billion for petroleum product imports—21% of total import payments in 2012.
[7] A *ger* is a tent-like dwelling used by nomadic people. The *ger* districts are mainly inhabited by people who cannot afford to live in apartments.
[8] These pollutants include carbon monoxide, volatile organic carbons (including formaldehyde, acetaldehyde, and acetone), polycyclic aromatic hydrocarbons, and particulate matter (including black carbon).

The population of Ger District has been rising because of an influx of migrants from rural areas seeking employment opportunities in Ulaanbaatar.[9] This is increasing the use of conventional fuels, adding to the worsening air pollution problem.[10] A World Bank report attributes about 11% of premature deaths in the city to air pollution, and estimates the social cost at about $177 million–$727 million a year.[11] The World Health Organization (WHO) ranked Ulaanbaatar as the city with the second-worst air pollution in the world.[12] The WHO study found that 60%–90% of the air pollution is caused by raw coal and wood combustion for heating and cooking in Ger District.

5. Most of the electricity demand in Mongolia is met by coal-fired power plants, which have limited flexibility to change their output in timely manner in response to the commands of the grid operator. Although Mongolia has abundant renewable energy resources, such as wind and solar, capitalizing on these sources remains a challenge because the power system lacks the regulating capacity to cope with the power fluctuation from power plants based on renewable energy.

6. In view of these challenges, Mongolia is seeking to explore alternative fuel solutions to (i) decrease dependence on oil imports and thereby improve energy security, (ii) reduce air and soil pollution in Ulaanbaatar caused by coal combustion for heating and cooking in Ger District, and (iii) install regulating capacity such as gas-based power plants in the power system for absorbing renewable energy-based power. One option is to consider CTL technology, which would use domestic coal to produce petroleum products and clean gas fuels.[13] The benefits of CTL are particularly important for Mongolia, with its large reserves of coal[14] and dependence on oil imports. CTL could produce alternative fuel cost-effectively, particularly when international oil prices are consistently high. It can help the country develop strategic gasoline- and diesel-equivalent reserves to overcome frequent supply interruptions. Combined with technology for capturing carbon dioxide emissions from these plants and sequestering them geologically—a process known as carbon capture and storage—CTL plants can reduce associated carbon dioxide emissions by 90%.[15]

7. But such CTL plants, due to their complexity and size, are capital intensive and will require large private investment. ADB has supported Mongolia in reforming its regulatory framework to attract private investment, leading to a successful large scale public–private

[9] About 42% of the population of Mongolia lives in Ulaanbaatar and 58% of its residents (about 186,000 households) live in *ger* districts.

[10] During the long winter months, particulate matter of less than 10 micrometers in diameter in Ulaanbaatar's atmosphere routinely measures 279 micrograms per cubic meter—about 5 times higher than the air quality guidelines of 50 micrograms per cubic meter of the World Health Organization (WHO).

[11] World Bank. 2011. *Air Quality Analysis Ulaanbaatar: Improving Air Quality to Reduce Health Impacts*. Washington, DC.

[12] WHO. 2012. *World Health Statistics*. Geneva.

[13] CTL is the process of coal liquefaction, during which many pollutants, including sulfur, can be removed. Coal liquefaction first gasifies the coal with steam to form a syngas. Sulfur is removed from this gas and the mixture adjusted according to the desired product. The syngas is then condensed over a catalyst, using the Fischer–Tropsch process—to produce high-quality, ultraclean products. Dimethyl ether—a byproduct of coal-to-liquid—is an environmentally clean gas suitable for heating and cooking. It is convenient to transport and generates no sulfur oxide or soot. It can also be used as an alternative to diesel for transport, as well as to generate electricity.

[14] Mongolia has proven reserves of 12.2 billion tons of coal, including 2.0 billion tons of coking coal and 10.1 billion tons of thermal coal.

[15] R. Williams, E. Larson, and H. Jin. 2006. Synthetic Fuels in a World with High Oil and Carbon Price. Paper presented at the Eighth International Conference on Greenhouse Gas Control Technologies, Trondheim, Norway. 19–22 June.

partnership project in the country's energy sector.[16] The policy and regulatory framework around CTL projects needs to be further examined to remove barriers and create an enabling environment for private investment in this field.

III. THE POLICY AND ADVISORY TECHNICAL ASSISTANCE

8. The TA will help the government (i) undertake a feasibility analysis of CTL; (ii) review the legal and regulatory framework for implementing CTL projects, including energy security strategy and policies; (iii) identify and propose measures to stimulate private sector interest in CTL projects; and (iv) recommend measures to create an enabling environment for investments for CTL projects.[17]

A. Impact and Outcome

9. The impact will be improved air quality and energy security in Mongolia due to cleaner fuel supply from CTL. By 2025, a large-scale CTL project will have been implemented, more than 20% of low-quality petroleum products will have been replaced by the clean gas fuel and high-quality petroleum products, Ulaanbaatar's air pollution index and Mongolia's trade balance will have improved, and imports of petroleum products will have declined. The outcome will be an enabling environment for CTL established by 2016. This will be indicated by the (i) development and approval by the government of a CTL feasibility assessment and implementation plan, (ii) tabling before the Mongolian legislature of policy and regulatory changes in favor of CTL, and (iii) approval by the government of gas fuel safety rules and associated infrastructures.

B. Methodology and Key Activities

10. The key outputs of the TA include (i) technical and economic feasibility of CTL established, (ii) policy and regulatory environment assessed, (iii) CTL implementation plan developed, and (iv) TA findings and recommendations disseminated.

11. The main assumptions are that timely investments are made in CTL projects; the government remains committed to CTL projects; feasibility assessment are positive; and timely access is given to records, information, and personnel. The main risks of the TA are (i) government inaction discourages investments, (ii) gas fuel safety rules are not in place and associated infrastructures are not built, (iii) CTL is found not to be feasible in Mongolia, (iv) the government considers the associated policy and regulatory needs to be too demanding, and (v) the local counterpart's performance is weak.

C. Cost and Financing

12. The TA is estimated to cost $350,000, which will be financed on a grant basis by ADB's Technical Assistance Special Fund (TASF-V). The government will provide counterpart support

[16] ADB's public sector initiated and supported the preparation of the feasibility study for 450 megawatt combined heat and power plant number 5 (CHP5), estimated to cost nearly $1 billion in Ulaanbaatar using a public–private partnership modality. ADB was appointed as transaction advisor and ADB's Private Sector Operations Department is a lead arranger of the syndicated loan. The government and the concessionaire are negotiating a concession agreement with support from ADB's transaction advisory team.

[17] Actions including providing stable and favorable commercial environment in terms of legal, tax regimes, incentives to attract foreign and domestic investments, and supporting the implementation of gas fuel market by renewing safety rules.

in the form of office accommodation, logistics, facilities, remuneration of counterpart staff, studies, reports, data and requisite information, and other in-kind contributions. The cost estimates and financing plan are in Appendix 2.

D. Implementation Arrangements

13. The executing agency will be the Ministry of Mining and Energy. The implementing agency will be the Mineral Resources Authority of Mongolia. The TA will be implemented over 13 months, from 1 February 2015 to 29 February 2016. It will require 6 person-months of inputs from international experts and 15 person-months of inputs from national experts. The executing agency and implementing agency will be supported by a working group with representatives from the Ministry of Finance, the Ministry of Environment and Green Development, and Ulaanbaatar City's Air Quality Department. The working group will provide overall strategic direction and review the outputs of the consultants. Periodic meetings will be organized for the working group to discuss the progress of the TA.

14. A firm with a team of international experts (6 person-months) and national consultants (15 person-months) with expertise in energy economics, coal gasification, financial analysis, and environmental assessment will be hired to conduct the study using ADB's quality- and cost-based selection method (with a technical–financial weighting of 90:10), following submission of biodata technical proposal. The consultants will be engaged by ADB in accordance with the Guidelines on the Use of Consultants (2013, as amended from time to time). The outline terms of reference for consultants are in Appendix 3. ADB's Procurement Guidelines (2013, as amended time to time) will be followed and the shopping method will be used to procure the equipment under the TA. Equipment will be used by the consultants during implementation and handed over to the executing agency upon completion of the TA. Proceeds of the TA will be disbursed in accordance with ADB's *Technical Assistance Disbursement Handbook* (2010, as amended from time to time).

15. The TA will be monitored based on the consultants' progress report, and TA review missions. Two workshops will be organized for the interim and draft final report consultation, inviting government officials, licensed power companies, potential investors, donors, and members of Parliament. The overall results of the TA and lessons learned from other similar CTL projects will be disseminated through workshops, trainings, and study tours.

IV. THE PRESIDENT'S DECISION

16. The President, acting under the authority delegated by the Board, has approved the provision of technical assistance not exceeding the equivalent of $350,000 on a grant basis to the Government of Mongolia for the Coal to Cleaner Fuel Conversion for Heating in Ger District and Power Generation, and hereby reports this action to the Board.

DESIGN AND MONITORING FRAMEWORK

Design Summary	Performance Targets and Indicators with Baselines	Data Sources and Reporting Mechanisms	Assumptions and Risks
Impact Improved air quality and energy security in Mongolia due to cleaner fuel supply from CTL	A large-scale CTL project implemented by 2025 More than 20% of low-quality petroleum products and dirty coal replaced by clean gas fuel and high-quality petroleum products by 2025 (none in 2012) Air pollution index improved by 2025 Imports of petroleum products decline by 2025 (1.2 million tons in 2012)	Statistical bulletin of National Statistical Office of Mongolia on petroleum products production and import Statistical bulletin of National Statistical Office of Mongolia on health situation National statistics	**Assumption** Investments in CTL project are timely **Risks** Government inaction discourages investment Gas fuel safety rules are not in place and associated infrastructures are not built
Outcome Enabling environment for CTL established by 2016	CTL feasibility assessment accepted by the government by 2016 CTL implementation plan approved by the government by 2016 Policy and regulatory changes in favor of CTL tabled before the Mongolian legislature by 2016 Gas fuel safety rules and associated infrastructures are approved by the government by 2016	Government resolutions, policies approved ADB sector assessment report in 2016	**Assumptions** Government remains committed to CTL projects Feasibility assessment outcome is positive **Risks** CTL is found not to be feasible for Mongolia Associated policy and regulatory needs are considered too demanding by the government
Outputs 1. Techno-economic feasibility of CTL established 2. Policy and regulatory environment assessed 3. CTL implementation plan developed 4. TA findings and recommendations disseminated	Feasibility study undertaken and report submitted Assessment report submitted Implementation plan submitted At least two workshops completed for relevant organizations	Consultants' reports Workshop training materials	**Assumption** Timely access is given to records, information, and personnel **Risk** Performance of the local counterpart is weak

Activities with Milestones	Inputs
1. Establish techno-economic feasibility of CTL (3 months) 1.1 Assess environmental benefits. 1.2 Assess impact of high-grade coal-derived diesel and gasoline utilization instead of conventional imported petroleum products in automobile sector. 1.3 Assess coal-derived gas fuel implementation impact on decreasing Ulaanbaatar's air and soil pollution, substituting raw coal or wood in Ger[a] District. 1.4 Assess impact on improving health indicators and reducing social cost by solving air and soil pollution, including reduced premature deaths caused by air pollution, and increased life expectancy. 1.5 Assess natural forests preservation impact by not using wood for heating and cooking. 1.6 Assess lifecycle greenhouse gas emission considering also black carbon emission reduction. 1.7 Assess technical feasibility. 1.8 Assess technologies used for CTL. 1.9 Propose suitable technology for implementing CTL in Mongolia based on the types of coal, water resource, and weather conditions. 1.10 Propose most suitable technology and devices for coal gasification. 1.11 Identify the infrastructure required for different housing settings to use dimethyl ether for heating and cooking and the associated regulations. 1.12 Assess national security benefits. 1.13 Identify impact on increasing domestic supply and reducing import dependence of petroleum products. 1.14 Assess CTL plants' ability to sustain essential Mongolian infrastructure and major industries in case of reduced or halted petroleum supply by exporting countries. 1.15 Assess impact of improving bargaining power with foreign petroleum product suppliers. 1.16 Assess impact of a cleaner environment in Ulaanbaatar on social stability or prevention of social unrest due to poor environmental conditions for Ulaanbaatar residents. 1.17 Assess economic benefits. 1.18 Assess impacts on increasing tax base of diversification from mining sector to industrial sector. 1.19 Identify benefits on improving trade balance, decreasing cash outflow abroad, increasing gross domestic product, and economic growth of Mongolia by producing value-added domestic products, and their contribution to currency stabilization. 1.20 Assess potential contribution to the improvement of the Mongolian investment environment of implementing mega projects such as CTL plant, and its impact on attracting more foreign direct investment into Mongolia. 1.21 Assess contribution of creating employment opportunities outside Ulaanbaatar and leading to decentralization of Ulaanbaatar. 1.22 Assess impact of introducing new chemical industry with its advanced technologies into Mongolia on the development of its education system, creation of skilled employees, and scientific research. 1.23 Assess social benefits. 1.24 Assess the decrease in social cost achieved by solving Ulaanbaatar's air and soil pollution crisis. 1.25 Assess impact of decentralization of Ulaanbaatar and increasing employment outside Ulaanbaatar. 1.26 Assess impact of increasing employment in Ger District for gas	**ADB: $350,000** Note: The government will provide counterpart support in the form of office accommodation, logistics, facilities, remuneration of counterpart staff, studies, reports, data and requisite information, and other in-kind contributions.

fuel distribution network. **2. Assess policy and regulatory environment** (2 months) 2.1 Review the government's present and proposed petroleum sector policy, strategies, laws, regulations, and sector organizations. 2.2 Identify gaps between achievements and goals in the petroleum sector policy and strategy. 2.3 Review the government's activities for petroleum source diversification. 2.4 Review Mongolian petroleum sector's current situation, including government structure and private sector (petroleum importers, retailers). 2.5 Review Mongolian petroleum product import data (physical volumes, monetary amounts) for the past 10 years, conventional and unconventional petroleum exploration, development activities, including crude oil, oil shale, and CTL. 2.6 Review advantages and disadvantages of petroleum product production by conventional and unconventional methods. 2.7 Analyze Ulaanbaatar air pollution issues and determine impacts. 2.8 Assess possibilities of implementing gas fuel in *ger* districts. **3. Develop CTL implementation plan** (2 months) 3.1 Action plan for implementation of CTL projects 3.2 Propose development plan for promoting CTL projects. 3.3 Suggest business model for implementing CTL projects. 3.4 Submit to the government policy note with recommended policies for improving energy security to identify long-term strategy to solve Ulaanbaatar's air pollution and to determine industrialization development path. **4. Disseminate TA findings and recommendations** (2 months) 4.1 Conduct capacity building training and workshops on the advantages and benefits of CTL projects. 4.2 Hold interim and final consultation meetings to disseminate findings and lessons learned from other CTL projects. 4.3 Organize study tour to visit pilot CTL projects in other countries and learn best practice.	

ADB = Asian Development Bank, CTL = coal-to-liquid, TA = technical assistance.
[a] A ger is a tent-like dwelling used by nomadic people. The ger districts are mainly inhabited by people who cannot afford to live in apartments.
Source: Asian Development Bank.

COST ESTIMATES AND FINANCING PLAN

($'000)

Item	Amount
Asian Development Bank[a]	
1. Consultants[b]	
a. Remuneration and per diem	
i. International consultants	164.0
ii. National consultants	60.0
b. International and local travel	42.0
c. Reports and communications	10.0
2. Equipment[c]	5.0
3. Workshops, training, and study tour[d]	30.0
4. Miscellaneous administration and support costs[e]	10.0
5. Contingencies	29.0
Total	**350.0**

Note: The technical assistance (TA) is estimated to cost $350,000, of which contributions from the Asian Development Bank (ADB) are presented in the table above. The government will provide counterpart support in the form of office accommodation, logistics, facilities, remuneration of counterpart staff, studies, reports, data and requisite information, and other in-kind contributions. The value of government contribution is estimated to account for 10% of the total TA cost.

[a] Financed by ADB's Technical Assistance Special Fund (TASF-V).

[b] A consulting firm will be recruited to undertake the studies.

[c] Includes the cost of two laptop computers. These assets will be turned over to the executing agency upon completion of the project.

[d] Includes the cost of resource persons and supporting the travel expenses of three to five staff from relevant agencies to participate in overseas study tours in pilot coal-to-liquid projects in ADB member countries such as the People's Republic of China, Germany, and the Republic of Korea. The interim and draft final workshops will be held in Ulaanbaatar.

[e] Includes a national coordinator to support the organization of the knowledge-sharing workshop and trainings.

Source: Asian Development Bank estimates.

OUTLINE TERMS OF REFERENCE FOR CONSULTANTS

1. A consulting firm will provide a team of international and national consultants. The government will provide counterpart support to consultants, including (i) adequately heated office space (with basic furniture, an international telephone line, and internet access); (ii) bilingual counterpart personnel available to work full time, if required; (iii) assistance with visas, accommodation, and other permits required by the consultants to enter Mongolia and work; and (iv) access to all data, including documents, reports, accounts, drawings, and maps; and permission to enter offices, as appropriate and necessary, to undertake the work. The outline terms of reference of consulting services are as follows:

A. International Consultants (6 person-months)

2. **Energy economist and team leader** (1 person-month). The economist should have a postgraduate degree in economics or a related discipline, and at least 15 years of work experience in energy sector assessment. The economist will undertake the following tasks:

(i) Review the government's present and proposed petroleum sector policy, strategies, laws, regulations, and organization. Identify gaps between achievements and goals in the petroleum sector policy and strategy.
(ii) Review Mongolian petroleum product import data and cash flow since 2004. Identify the economic benefits of decreasing cash flow to exporters.
(iii) Identify the impact of value-added product to overall economic activity in the country.
(iv) Collect and review demand and production forecasts for petroleum products up to 2048.
(v) Identify impacts of increasing employment in Ger[1] District in the gas fuel distribution business.
(vi) Make a statistical analysis of social and economic impacts of new job creation on local district.
(vii) Identify opportunities for public and private sector investment in coal-to-liquid (CTL) in Mongolia.
(viii) Identify economic impacts of CTL project on gross domestic product, development speed, and economic expansion of Mongolia and the local area (plant district).
(ix) Identify the economic benefits of reducing air pollution in Ulaanbaatar.
(x) Review investment in the petroleum product sector in the past 10 years or more, and analyze its trend.
(xi) Prepare capacity development module and conduct capacity development training and seminars on energy sector analysis and planning.
(xii) Determine health benefits and social cost reduction of solving air pollution problem utilizing gas fuel from CTL plants.

3. **Energy specialist and coal gasification specialist** (3 person-months). The specialist should have postgraduate degree in engineering or a related discipline, and at least 10 years of work experience in the coal gasification process. The specialist will undertake the following tasks:

(i) Review and analyze CTL project possibilities, advantages, and disadvantages.

[1] A ger is a tent-like dwelling used by nomadic people. The ger districts are mainly inhabited by people who cannot afford to live in apartments.

(ii) Prepare a policy note specifying the gaps and issues in the petroleum product sector, the priority agenda, and actions for energy sector reform and development, including performance benchmarks, the size of petroleum product sector investment, and funding sources up to 2014.
(iii) Develop quantitative and qualitative indicators of energy security, air pollution control and greenhouse gas abatement, energy diversification, energy efficiency, improving access to petroleum products, and social and environmental impact of CTL projects, for selecting unconventional methods of petroleum product production.
(iv) Assess the analysis and planning capacities of government ministries and agencies in relation to the petroleum product sector to identify core capacity development needs.
(v) Identify the infrastructure required for different housing settings to use dimethyl ether for heating and cooking, and determine the associated regulation required.
(vi) Propose the most suitable technology and devices for coal gasification.
(vii) Prepare the capacity development module, and conduct capacity development training and seminars on the analysis and planning of the petroleum product sector.
(viii) Hold interim and final consultation meetings inviting all officials concerned from the government and nongovernment organizations to disseminate findings and receive comments.

4. **Financial analyst** (1 person-month). The analyst should have postgraduate degree in finance, accounting, or a related discipline, and at least 10 years of work experience in corporate financial and managerial analysis. The analyst will undertake the following tasks:

(i) Prepare an indicative project cost and financing plan for the demonstration project or projects, including proposed business model and potential financing source.
(ii) Carry out an in-depth financial analysis for implementable CTL demonstration projects, including calculation of the financial internal rate of return and weighted average cost of capital, taking into account all the financial costs and benefits.
(iii) Check the financial viability for CTL projects and identify the cutoff of oil price when CTL becomes nonviable due to oil price decrease.
(iv) Conduct a comprehensive analysis of all risks associated with project revenues and costs, and conduct sensitivity analyses on the financial results.
(v) Assist the team leader in preparing the capacity development module, and conduct capacity development training and seminars on petroleum product sector analysis and planning.
(vi) Assist the team leader in holding interim and final consultation meetings inviting all officials concerned from the government and nongovernment organizations to disseminate findings and receive comments.

5. **Environment specialist** (1 person-month). The specialist should have postgraduate degree in engineering or a related discipline, and at least 10 years of work experience in the environment sector. The specialist will undertake the following tasks:

(i) Analyze Ulaanbaatar air pollution issues and determine its impacts.
(ii) Assess the possibility of implementing gas fuel in *ger* districts.
(iii) Identify the impact of gas fuel in the *ger* districts on air and soil pollution.
(iv) Determine the potential safety and health issues associated with using dimethyl ether for heating and cooking.

(v) Assess how air pollution caused by vehicle exhaust emissions can be reduced by using diesel, gasoline, and liquefied petroleum gas from CTL plants.

B. National Consultants (15 person-months)

6. The national consultants will comprise a coal gasification specialist and deputy team leader, an energy economist, an environment specialist, an urban planning expert, and a financial analyst. They will pair with the corresponding international consultants and assist them in performing their terms of reference.

C. Reporting Requirements

7. The consultant shall submit the following reports to the Asian Development Bank (ADB) (both in English and Mongolian) and to the government (in Mongolian):

(i) **Inception report.** It will be submitted within 2 weeks after the commencement of the services. The report includes a detailed work program plus any major inconsistencies in the terms of reference.

(ii) **Interim report.** It will be submitted within 3 months after the commencement of the services. The report includes an interim result of activities, updated work program, and any issues and concerns.

(iii) **Draft final report.** It will be submitted within 6 months after the commencement of the services. Upon submission of the draft final report, a final consultation will be held, attended by relevant stakeholders, to obtain feedback on the report.

(iv) **Final report.** It will be submitted within 1 month after receipt of comments from ADB and the government on the draft final report. The final report shall take into consideration the comments of ADB and the government.